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# Risk Assessment and Sustainable Development: Towards a Concept of Sustainable Risk\*

Michael D. Mehta\*\*

## Introduction

Increased awareness of ecological limits to industrial growth has stimulated considerable interest over the past three decades in developing tools and techniques for managing health and environmental risks. Unfortunately, such approaches often neglect the relationships between human health, ecosystem integrity and economic concerns. This paper examines two of these dominant approaches, namely risk assessment and sustainable development, and suggests how a union of these can stimulate the formation of a new, integrative approach I provisionally call "sustainable risk."

Environmental policy is replete with difficult decisions that affect the health and well-being of present and future generations. The risks<sup>1</sup> associated with many industrial activities are often assessed in terms of morbidity and mortality statistics for populations exposed to a particular hazard. Rates of cancer, deaths from occupational accidents and genetic damage from chemical or radiation exposure are examples of how risk is used to evaluate the impact of different technologies. Inherent in these calculations of harm is the notion of benefit, that is, how industrially-produced risks usually result from the generation of socially valuable processes and products like electricity, employment, and consumer goods. The balancing act for policy-makers is to ascertain the socially acceptable (or tolerable) level of risk so that they do not exceed derived benefits. Also, lest decisions place an unfair burden on future generations, the benefits to present generations must

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<sup>1</sup> For example, The Oxford Dictionary of the English Language (1991) defines risk as the "chance or possibility of loss or bad consequence." Yet, as discussed below, those who study risk have definitions of this concept which range in complexity.

not be obtained at the expense of those yet to be born. This latter concept is known as "sustainable development." It will be argued here that the formulation of "good" environmental policy requires integration of risk assessment as a tool and sustainable development as a principle. Before we continue, definitions are needed, but because these terms have been exhaustively defined elsewhere, my review will be brief.

### The Concept of Risk

Mandl and Lathrop cite common risk definitions:<sup>2</sup>

- (1) The expected number of fatalities per year resulting from the consequences of an accidental event.
- (2) The probability of an injurious or destructive event generated by a hazard, over a specified period of time.
- (3) The frequency at which certain numbers of acute fatalities are expected from accidents.

These definitions suggest that risk arises from both a hazard and some uncertainty about its effects. As such, a hazard is a necessary precursor, and the probability of its occurrence multiplied by its consequences is one way of understanding risk.

Krimsky and Plough<sup>3</sup> define hazard as a source of danger. Risk includes the likelihood of a hazard developing into an actual adverse effect causing loss, injury or some other form of danger. Kaplan and Garrick illustrate this difference:<sup>4</sup>

The ocean is a hazard. If one attempts to cross the ocean in a small rowboat, a great risk is incurred. If the crossing is made aboard the Queen Elizabeth, the risk is reduced — all else being equal.

The ocean-going vessel is a device used as a safeguard against the hazard. In general, risk may be diminished by increasing safeguards but never eliminated unless the hazard itself is removed.

Risk can be either the probability of a hazard having adverse effects on an individual in a population or the number of times an event could occur in a population.<sup>5</sup> When risk refers to the expected number of

<sup>2</sup> Christoph Mandl & John W. Lathrop, *Risk and Decision*, in *Risk Analysis and Decision Processes*, (H. C. Kunreuther et al., eds. 1983).

<sup>3</sup> Alonzo Plough & Sheldon Krimsky, *The Emergence of Risk Communication Studies: Social and Political Context*, 12 *Sci., Tech., and Human Values* 4 (1987).

<sup>4</sup> Stan Kaplan & B. John Garrick, *On the Quantitative Definition of Risk*, 1 *Risk Analysis* 11 (1981).

<sup>5</sup> Chris Whipple, *De Minimis Risk* (1987).

mishaps in a population, it is the product of the size of population at risk and probability that an individual will experience the hazard. To summarize, hazards are sources of danger, whereas risk is the possibility or probability of loss from a hazard.<sup>6</sup>

The U.S. National Research Council has gone a step further by outlining a four-stage process for performing risk assessments.<sup>7</sup> The first step in this process involves identifying the hazard and determining the types of effects expected if exposure occurs. These “endpoints” include effects leading to cancer, damage to the reproductive system, developmental and genetic damage, and damage to organs. The second step usually involves the use of toxicology to determine the dose-response ratio for exposure to a particular hazard. A way to think of this relationship is to compare dose-response to the effects of increasing alcohol consumption on humans. In this example, the more alcohol consumed, the greater impairment, and more damage to liver and other organs. Exposure assessment is the third step in this process since it is necessary to know by what mechanisms and pathways exposure occurs. Common pathways for chemicals such as chlorine, often used to treat municipal drinking water supplies, include oral consumption, dermal absorption, and atomization by shower heads and other sources. The fourth step in assessing risk involves characterizing the exposed population. Demographic characteristics such as gender ratio, age distribution, racial composition, habits, and practices — such as consuming garden-grown produce — influences exposure, contribution by pathway, and biological effects. For example, individuals living near nuclear power generating stations in the Province of Ontario are exposed to tritium, a radioactive form of hydrogen.<sup>8</sup> Tritium can be found in drinking water and air. It can also be found in an organically-bound form in local food supplies. Risk assessors need to know how much locally grown produce individuals consume to accurately

<sup>6</sup> Michael D. Mehta & Paul Simpson-Housley, *Perception of Potential Nuclear Disaster: The Relation Between Likelihood and Consequence Estimates of Risk*, 79 *Perceptual & Motor Skills* 1119 (1994).

<sup>7</sup> National Research Council, *Risk Assessment in the Federal Government: Managing the Process* (1983).

<sup>8</sup> Michael D. Mehta, *Risk and the Canadian Nuclear Industry: A Democracy-Technocracy Quandary* (1995) (Ph.D. Thesis).

calculate the radiation dose from all sources. Since many radioactive substances (and pesticides) remain active for long periods of time, risks to future generations result, in part, from earlier industrial activities. As such, a sustainable level of acceptable risk for present and future generations must be planned accordingly.

The ubiquitous nature of modern-day environmental risks places considerable financial strain on regulatory bodies who are charged with identifying toxic substances, weighing scientific evidence from toxicological and epidemiological studies, and determining a regulatory level for safety. The success of these endeavors has been marginal for a small group of identified chemicals, but an abysmal failure on a larger scale. For example, in 1992 the U.S. Environmental Protection Agency (EPA) had approximately 70,000 substances listed in its "Toxic Substances Control Inventory."<sup>9</sup> Information on health effects is available for only 9,600 substances, and between 2,000 and 3,000 new chemicals are being registered annually. Pesticide regulation in the U.S. is equally ineffective with "only six of some six hundred active ingredients mandated for registration..." by 1985.<sup>10</sup>

In Canada the situation is no better. The "Domestic Substances List," a compilation of approximately 28,000 substances manufactured in or imported to Canada, lists only 44 substances as a priority for regulation.<sup>11</sup> In a sense, this inability to cope with a large number of substances represents a failure of regulatory agencies and risk assessment to handle the hazards posed by some chemicals. The relatively long time frames needed to conduct scientifically rigorous risk assessments limits the number of chemicals that can be studied, and consequently populations are exposed to unregulated levels of the remaining unstudied chemicals. This situation is unlikely to improve since new chemicals are rapidly being developed and costs associated with assessing their impacts on human health and environment continues to steadily increase. The need for a new, or different, approach has never been clearer. Perhaps this gap can be filled, at least partially, by some of the principles espoused by proponents of sustainable development.

<sup>9</sup> Evelyn B. Lorque, *Critical Technologies and New Enabling Materials: Environmental Impacts and Policy Implications* (1992) (unpublished).

<sup>10</sup> Christopher J. Bosso, *Pesticides and Politics* 226 (1987).

<sup>11</sup> William Leiss, *Governance and the Environment*, 4th Ann. Bell Canada Papers Conf., Kingston Ontario, Nov.1995.

## The Concept of Sustainable Development

Sustainable development was first mentioned in a 1980 report<sup>12</sup> and formally recognized in another report by the World Commission on Environment and Development in 1987.<sup>13</sup> The latter report briefly reviews global fiscal and environmental crises and outlines strategies that call for an end to trade protectionism, an endorsement of trade liberalization, and several prescriptive recommendations including changes in how the World Bank, United Nations and transnational corporations operate. These recommendations embrace several practices, policies and technologies designed to meet the economic and social needs of the present without compromising the needs of future generations. Since this report was released, several countries including Canada have developed strategic plans to address these concerns.

Canada's defunct Green Plan defines priority objectives for a "safe and healthy environment" and a "sound and prosperous economy" which are consistent with sustainable development as outlined in the Brundtland Report. The Green Plan outlines the following objectives for ensuring a safe environment and a healthy economy:<sup>14</sup>

- (1) a commitment to maintaining clean air, water and land;
- (2) sustainable use of renewable resources;
- (3) protection of special spaces and species;
- (4) preserving the integrity of the North;
- (5) ensuring global environmental security;
- (6) environmentally responsible decision-making at all levels of society; and
- (7) minimizing the impacts of environmental emergencies.

It is clear from these goals that safeguarding the environment for future generations, while promoting present economic prosperity, should achieve an optimal balance between medium and long-term risks and shorter-term benefits. In other words, following a plan for achieving sustainable development for future generations may have the added bonus of protecting those presently living from exposure to unacceptably large risks. However, following the principles of risk assessment is no guarantee that sustainable practices will be adopted.

<sup>12</sup> International Union for the Conservation of Nature, *World Conservation Strategy* (1980).

<sup>13</sup> *Our Common Future* (1987) (also known as the Brundtland Report).

<sup>14</sup> Government of Canada, *Canada's Green Plan 9* (1990).

## Risk and Sustainable Development: Spanning the Chasm

At first glance the links between risk assessment and sustainable development seem weak or perhaps even non-existent. This is probably why very few papers have been published on the topic.<sup>15</sup> Risk assessment is often viewed as a policy tool for supporting, or even justifying, a particular approach to solving a technical or administrative problem. Since risk assessments are technical in nature, expensive to conduct, and take considerable time, this tool has been virtually inaccessible to the average citizen or environmental group. Large corporations, utility companies, and governmental agencies are usually among those using risk assessment. Moreover, this approach has been largely confined to assessing the human health effects resulting from exposure to a specified hazard: the protection of ecosystems including wildlife management and promotion of biodiversity are not considered. By contrast, the concept of environmental sustainability (although vague and hotly contested) is viewed by many as a soft-edged, philosophically-oriented approach for curbing, or reversing, industrial development, or at least minimizing its impact.<sup>16</sup> Sustainable development is concerned with the protection of natural resources including forestry, fisheries, and mining. Such resources, though, are viewed as "goods" that should be harvested in a sensible, sustainable way. Others like "deep ecologists" perceive such practices as reprehensible, and prefer that nature be valued for its own sake without recourse to economic valuation criteria.<sup>17</sup> A bringing together of risk assessment and sustainable development is needed if environmental protection, promotion of human health, and fostering of economic development are to be achieved simultaneously.

Lester Brown<sup>18</sup> has viewed a sustainable society as one with a stable population, where land is conserved and renewable resources are used wisely, where the protection of forests and fisheries is necessary to ensure biodiversity. Nowhere in the four-stage process of risk

<sup>15</sup> See, e.g., Michael Manning & David Rejeski, *Sustainable Development and Risk: A Fit?* (1994).

<sup>16</sup> See *Global Ecology: A New Arena of Political Conflict* (Wolfgang Sachs, ed. 1993) (a critique of sustainable development).

<sup>17</sup> See Murray Bookchin & Dave Foreman, *Defending the Earth* (1991).

<sup>18</sup> Lester Brown, *Building a Sustainable Society* (1981).

assessment outlined earlier do these types of concerns get addressed. One of the central dimensions of sustainable development, namely inter-generational equity, also appears to be absent from risk assessment.

The Brundtland Report outlines the importance of addressing the relationship between natural resource management and economic development. The extraction of non-renewable resources coupled with increasing levels of pollution from anthropogenic sources, make it clear that changes in the way industries operate is necessary. Jean-Guy Vaillancourt summarizes the spirit of the Report:<sup>19</sup>

It is quite clear that the Brundtland Report did not intend to be an exercise in the legitimation of current economic operations of major industrial corporations bent on extracting rapidly non-renewable resources in order to make short-term mega-profits, nor a call to have them make a few cosmetic changes in their activities.... On the other hand, it [the Report] does not legitimate either the bucolic vision of certain utopian deep ecologists, who want to preserve all of nature in its pristine state, and who dream of an impossible return to an idealized neo-paleolithic mode of life, to a paradise lost, to a reconstructed Garden of Eden, where humans live in complete harmony with an untouchable and quasi-deified nature.

From its inception, the concept of environmental sustainability meant considering the economic impacts of decisions on resource use and allocation. It implies that economic instruments like emissions credits and shadow pricing mechanisms makes environmental stewardship more profitable for some industries, improves the health and well-being of ecosystems and humans overall, and stimulates the impetus for greater social and economic equity. These improvements are compatible with the goals of risk assessment; namely, to protect human health while maintaining sustainable patterns of economic development. Although risk assessment is not normally understood in this way, it is essential that the links with sustainable development be made stronger (or more obvious) in order to promote better, fairer (equitable), and more timely environmental policy. The next sections of the paper will examine these links, and some discontinuities, and suggest how greater

<sup>19</sup> Jean-Guy Vaillancourt, *Sustainable Development: a Sociologist's View of the Definitions, Origins and Implications of the Concept*, in *Environmental Sociology: Theory and Practice* 219 (Michael D. Mehta & Eric Ouellet, eds. 1995).



integration of these concepts could benefit human health, environment, and economic development. We will examine cost-benefit analysis, market-based approaches, and voluntary initiatives like Canada's ARET challenge to explore this relationship.

### Cost-Benefit Analysis: Environmental Protection as "Public Good"

The notion of a "public good" was developed with the work of Adam Smith<sup>20</sup> who recognized that certain goods and services must be provided by government. If left to the forces of the free market, supply would be insufficient to meet needs, since individuals acting in their own self interest would be insufficiently motivated to accept diminishing marginal returns. According to public goods theory, support of public schools, the military, law enforcement, highway construction, and environmental protection are some examples of where government intervention is required.

Purchasing environmental protection (e.g., regulations, enforcement) qualifies as a public good since a clean environment is enjoyed by all (nonrivalry) and costs of excluding individuals from benefiting once the good is produced is high (nonexclusivity). An examination of the cost-benefit paradigm and its relation to risk assessment and sustainable development illustrates how a "harm avoided" approach to environmental protection defies the forces of supply and demand, thus changing the relationship between environment and economy.

If economic performance is tied to the extraction of natural resources (or at least the ability to control access), and the earth is used as a sink for industrial byproducts, then collapsing ecosystems endanger not only human health but also the economy. In a very real sense, physical limitations resulting from reduced availability of non-renewable resources now constrain economic growth. An examination of global patterns of development and underdevelopment clearly show this relationship. For example, the distribution (and sufficiency) of per capita food and energy consumption is directly correlated. The per capita annual consumption of energy for individuals living in Canada and the U.S. falls between the mass equivalent of 8,000 and 20,000kg

<sup>20</sup> Adam Smith, *The Wealth of Nations* (Penguin 1987) (first published 1776).

per person.<sup>21</sup> Not surprisingly these countries have also more than enough food. By contrast, countries like Ecuador, Somalia, Mali and Pakistan have “insufficient” supplies of food — and very low energy consumption.<sup>22</sup> Thus, “advanced” Western societies have little need to worry about food or energy; in both cases surplus exists. What we should worry about are the forces of globalization and restructuring required if our industries are to remain competitive. This is a key reason why cost-benefit analysis is deemed important for assessing the impact of environmental regulations on the economy — and is behind regulatory reform efforts. Sustainable risk holds the potential of being a set of concepts and tools to guide economies to be more environmentally friendly and economically efficient.

The EPA has been required for the past fifteen years to quantify the benefits of environmental protection, relative to costs, using traditional cost-benefit analysis. Holly Stallworth of the EPA cites three shortcomings associated with this approach.<sup>23</sup> First, cost-benefit analysis treats environmental protection as a consumer good, while often ignoring the public goods aspect of environmental quality. Second, cost-benefit analysis collapses “complex questions of social value into market prices, blurring the distinction between individual and collective choice.”<sup>24</sup> Third, cost-benefit analysis fails inter-generational tests of equity by assuming that existing distributions of income and property rights should be the basis for valuing future needs, while ignoring the irreversibilities of environmental decisions. Although environmental quality has always been a public good, the “harm avoided” aspects of environmental protection defies traditional market-based valuation. This has not prevented governments from insisting upon such valuations nonetheless.

The Clinton Administration, acknowledging that benefits from environmental regulations may be hard to measure, placed the burden of proof on regulatory agencies to quantify the economic benefits of

<sup>21</sup> See World Environment Atlas (1991) and Environment Atlas (1992).

<sup>22</sup> *Id.*

<sup>23</sup> Holly Stallworth, *The Cost-Benefit Paradigm for Environmental Protection: An Economist's Perspective on the Methodological, Theoretical, and Ethical Problems* (U.S. EPA, Off. Strat. Plan. & Env'l Data 1994).

<sup>24</sup> *Id.* at 1.

major regulations.<sup>25</sup> The fundamental tenet of this conservative environmental policy is that costs of regulations should not exceed their ecological and public health benefits.

A study of the costs of 587 life-saving interventions by Tengs et al. provides a useful way for agencies to compare the value of different safeguards.<sup>26</sup> Although accuracy of the data and assumptions under which it was originally gathered pose serious limitations on interpreting the results, orders of magnitude for different interventions can be spotted easily. According to this study, the median intervention costs \$42,000 per life-year saved. There are several very expensive interventions as well some very low cost ones. For example, arsenic emission controls for glass manufacturers costs \$51M<sup>27</sup> for each life-year saved. Other expensive interventions include controlling trichloroethylene levels in drinking water (\$34M) and banning chlorobenzilate from citrus farming (\$1.2M). Interventions that fall near the median include child resistant cigarette lighters, flashing lights at railway crossings, cervical cancer screening for women over 65 and radon gas remediation in homes with levels greater than or equal to 8.11 pCi/L. The best deals, so to speak, come mostly from health care interventions, with few exceptions including mandatory seat belt use (\$69). Prescribing beta blockers for myocardial infarction survivors costs \$360 per life-year saved. Other low cost interventions include influenza vaccinations (\$140), defibrillators for ambulances (\$39), and measles, mumps and rubella vaccinations of children (savings exceed costs). The implication of comparing costs is that resources should be spent on, e.g., automobile seatbelts and airbags and immunizations rather than pollution control. The Tengs et al. study is an example of cost-benefit analysis applied in an area that has been the preserve of risk assessment, i.e, risk of human death. The concept of sustainable risk suggests that cost-benefit analysis can also be applied to a broader economic development issue, say a waste disposal site on sensitive lands.

<sup>25</sup> Exec. Order No. 12866, 58 F.R. 51,735 (1993). The Reagan and Bush Administrations in a climate of "getting government off the backs of business" issued Executive Order 12291 to require cost-benefit analysis of regulations with effects on the economy in excess of \$100 million.

<sup>26</sup> Tammy Tengs et al., *Five-Hundred Life-Saving Interventions and Their Cost Effectiveness*, 15 Risk Anal. 369 (1995).

<sup>27</sup> All figures in 1993 U.S. dollars.

Using the principles of cost-benefit analysis to set regulatory priorities helps bring risk assessment and sustainable development closer together. If the goal of environmental policy is to protect human health and environment while stimulating economic development, then we need to better understand what is meant by the term "acceptable risk." For the risk assessor, acceptable usually means a level of risk comparable to other risks normally embraced, or at least tacitly accepted. This is problematic since the greatest risks to human health come from life-style factors including smoking and poor diet. It would be politically unacceptable for industry to expose individuals to pollutants with a level of risk equivalent to these life-style risks, and transferral of risks to future generations is equally unfair.

Cost-benefit analysis places an artificially low value on those yet to be born, and no value on, e.g., animals or plants. If the costs of industrial development and pollution are considered in the long run, risks will be automatically reduced. For example, the generation of electricity with nuclear power poses a variety of risks bounded by different time frames. Emissions of radioisotopes on a day-to-day basis threaten the health of local residents (e.g., higher rates of childhood leukemia and Down's Syndrome). Also, the probability of a large scale nuclear accident like Three Mile Island or Chernobyl increases with the number of facilities operating and the years of operation. Safely disposing of nuclear waste is an obvious illustration of how cost-benefit analysis interacts with time-frames to link risk assessment and sustainable development.

A joint venture of Atomic Energy of Canada Limited (AECL) and Ontario Hydro to dispose of high-level radioactive waste in geological vaults is a good example. A summary of an environmental impact statement by AECL on the concept of deep geological disposal of nuclear waste quotes Canada's nuclear regulator, the Atomic Energy Control Board (AECB):<sup>28</sup>

The burden on future generations shall be minimized by (a) selecting disposal options for radioactive wastes which to the extent reasonably achievable do not rely on long-term institutional controls as a necessary safety feature; (b) implementing these disposal options at an appropriate time,

<sup>28</sup> Atomic Energy of Canada, Ltd., *Summary of the Environmental Impact Statement on the Concept for Disposal of Canada's Nuclear Fuel Waste 5-6* (1994).

technical, social, and economic factors being taken into account; (c) ensuring that there are no predicted future risks to human health and environment that would not be currently accepted.

This clearly acknowledges the relationship between risk and its impact on present and future generations. Perhaps sustainable development and risk substantially overlap when long time horizons are considered. Low risk technologies that are socially acceptable today are unlikely to burden future generations with unacceptably large risks. The disposal of nuclear waste in underground caverns leads to two related questions. First, since nuclear technology creates long-lived waste byproducts that must be dealt with by future generations, with some inherent risk and no tangible benefits, is nuclear power a sustainable technology? Second, how can the “true” risks of nuclear power be assessed if risk assessment only considers the risks of exposure of those now living? A different tack for addressing such questions would be to discuss a logical and practical extension of cost-benefit analysis and its relationship to environmental policy; namely, market-based approaches.

### Market-Based Approaches

Historically, environmental standards have provided incentives for industry to develop or purchase state-of-the-art technology to comply. Such standards can be characterized as technology-based performance standards in that industries are expected not to exceed set limits for emissions of particular pollutants. Unfortunately, a limit imposed at a particular threshold offers few incentives for industry to reduce emissions more than required under a given standard. Conversely, industries that develop new technologies or practices for reducing emissions may be unduly penalized if regulators see that such reductions are possible, and then require them under amendments to existing regulations.

The use of economic instruments to stimulate pollution reduction provides industries with incentives that command-and-control regulations alone cannot. In some cases, the normally hidden costs of pollution are included in the prices of products; this is known as “shadow pricing.” For example, Nevada and Massachusetts assign specific dollar values to various air pollutants, including carbon dioxide

emissions from coal-fired generating stations. It has been estimated that the environmental cost of a new coal-fired plant is approximately 4.4 cents per kwh.<sup>29</sup> In general, economic incentives like shadow pricing are a stark contrast to traditional command-and-control. Incentives create rewards for preventing and controlling emissions and penalties for increasing emissions, effluents, or wastes.<sup>30</sup> In Canada's Green Plan an appreciation for this distinction is evident.<sup>31</sup>

The basic difference between regulations and economic instruments is that the former directly prescribe behaviour; they "command" polluters to "control" specific activities. Economic instruments, by contrast, use market signals to influence behaviour in a manner which is consistent with environmental goals; they focus on environmental results rather than methods.

Economic approaches are more important nowadays since many of the "easy," end-of-pipe sources of pollution have already been controlled.

Another type of economic incentive that helps us see the relationship between risk assessment and sustainable development is pollution reduction crediting. Unlike pollution fees and taxes (e.g., garbage disposal charges, tire and fertilizer taxes), credits reward industries for releasing less pollutants than their allowable annual maximums. Upon verification, crediting agencies like the EPA allows industries with such credits to trade or sell them to other industries who have exceeded annual limits. Such practices do not reduce overall levels of pollution in the short run, but give environmentally "friendlier" industries a competitive advantage by offsetting the costs of their products and services with pollution credits. Specific applications of crediting involve reducing pollutants responsible for acid rain (e.g., sulphur dioxide), ozone depletion (e.g., chlorofluorocarbons), and lead deposition (e.g., levels of lead in gasoline). The presumption of this approach is that eventually overall levels of pollution will be reduced when market mechanisms are activated. In this age of globalization, such advantages help industries in Canada and the U.S. by keeping

<sup>29</sup> Michael Totten & Nita Settina, *Internalizing Societal Costs* (1995).

<sup>30</sup> U.S. Environmental Protection Agency, *The United States Experience with Economic Incentives to Control Environmental Pollution* (1992).

<sup>31</sup> Government of Canada, *Economic Instruments for Environmental Protection* (1992).

goods and services competitively priced. As well, polluters have fewer economic incentives to continue with environmentally irresponsible activities. To work, this approach to pollution reduction must include a tariff system for imported products not manufactured within set emissions limits. Such an approach is consistent with the global, transboundary nature of today's most pressing environmental concerns, and will reduce the impact of industry on human health and environment. The North American Free Trade Agreement and other such agreements ought to address these issues.

When assessing risks of nuclear power generation, the Canadian regulator, the Atomic Energy Control Board, utilizes economic optimization approaches like ALARA ("as low as reasonably achievable"). ALARA optimization involves weighing the economic benefits of nuclear power (e.g., electricity, employment, international trade in reactor technology) with risks to human health and environment. In this context, risks from radiation exposure are treated differently than risks from chemicals such as pesticides or food additives. Mark Goldberg, comparing treatment of the radioisotope tritium to N-nitrosodimethylamine (NDMA) by Canadian regulators, notes that a *de minimis* criteria (a level of risk too trivial to warrant concern) is used for chemical risk assessments, while a top-down, risk management approach is used for radiation.<sup>32</sup>

For NDMA, found in food, consumer products and drinking water,<sup>33</sup> a *de minimis* level of  $10^{-5}$  is considered acceptable exposure through a single medium (e.g., drinking water), and  $10^{-6}$  if exposure occurs through multiple media or if a large population is exposed. Standards are set very differently for radiological contaminants. Starting with knowledge of background levels of radiation (approximately 1 mSv per year for the average Canadian)<sup>34</sup>, a top-down approach using ALARA is used to manage risks. The logic is that risks from the civilian nuclear power program can be no lower than the overall risks of cancer induction through background radiation

<sup>32</sup> Mark Goldberg, *Risk Assessment as a Regulatory Device*, in *Regulatory Efficiency and the Role of Risk Assessment* (Michael D. Mehta, ed. 1995).

<sup>33</sup> See David Cameron, *The Making of a Polluter: A Social History of Uniroyal Chemical in Elmira*, in *Environmental Sociology: Theory and Practice*, at 297.

<sup>34</sup> This dose of background radiation results in a life-time cancer risk of  $10^{-3}$ , or 1 extra cancer death per thousand exposed individuals.

exposures. In fact, ALARA optimization is used to decide how much greater the risks from anthropogenic sources of radiation can be relative to background levels, given the social and economic benefits (or costs) associated with this technology.

Although a valuable tool for understanding the relationship between radiological risk and economy, ALARA optimization is a temporal prisoner, and therefore incompatible with sustainable development. In addition to assuming that background levels of radiation are socially acceptable (and naturally occurring<sup>35</sup>), ALARA, and risk assessment in general, ignores the cumulative effects of present-day, small risks over time. Dealing with currently large risks (e.g., life-style factors) is the most efficient way to use scarce resources. Pragmatically, the benefits of most risk reduction strategies focusing on the individual are erased with the coming of each new generation. For example, the value of a temporary national campaign to teach male myocardial infarction survivors about high fiber, low fat diets, is substantially diminished once that generation has passed on. Certainly targeting individual behavior has some successes in the long run, but recent trends indicating that young females are taking up smoking in unprecedented numbers is disheartening. Arguably, efforts to mitigate life-style risks are non-sustainable, and may eventually result in larger environmental risks. Toxic chemicals and increased levels of radiation will reach a point where the risks to future human health will increase dramatically (e.g., ozone depletion, global warming). At the present time, using resources to address such risks is inefficient, yet waiting until these risks increase to a point where concern is valid, is unjust to future generations, and might be inefficient from an intergenerational perspective. This is the greatest obstacle that a convergence of risk assessment and sustainable development creates. An examination of how to improve environmental policy through more efficient modes of regulation may help address some of these concerns.

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<sup>35</sup> Several sources of background radiation include cosmic rays, radon gas and naturally occurring radioisotopes. Also, atmospheric testing of nuclear warheads for several decades contributes considerable radiation. See Rosalie Bertell, *No Immediate Danger* (1985).



### Voluntarism Versus Regulation: The Success of Canada's ARET Initiative

Environmental protection in Canada and the U.S. fails to protect adequately the integrity of ecosystems and human health. In the U.S., regulations are said to cost \$580 billion, approximately \$6,000 per household, per annum.<sup>36</sup> Specific figures aside, more efficient regulation is consistent with sustainable risk; it potentially streamlines risk assessment and improves economic performance of industries that generate them. In Canada, many fear that complying with unnecessary or overly restrictive regulations will damage Canada's ability to compete globally by raising costs of goods and services.<sup>37</sup> Yet, it must be admitted that many regulations save money and lives in the long run. The phasing out of lead in gasoline and childhood immunization for measles are examples of cost effective regulations. Yet, it is still a requirement (not enforced) in Canada that railway stations provide spittoons to reduce the threat of spreading tuberculosis. A fair question to ask is: How could environmental regulations be reformed to better protect human health and the integrity of ecosystems while simultaneously promoting economic growth?

A uniquely Canadian approach to "having your cake and eating it too" can be found in an initiative known as the Accelerated Reduction/Elimination of Toxics (ARET). This voluntary, multi-stakeholder consultation process was endorsed in principle by the Canadian Council of Ministers of the Environment in May 1993. ARET grew out of an initiative of a group called "New Directions" — a caucus of corporate executives and environmental leaders drawn together to accelerate the integration of environmental and economic factors in decision making.<sup>38</sup> The ARET process seeks to reduce possible adverse impacts caused by potentially toxic substances as soon as possible. ARET stakeholders involved in a subcommittee charged

<sup>36</sup> John D. Graham, *The Role of Risk Analysis and Benefit-Cost Analysis in Regulatory Reform Legislation*, Testimony on the Regulatory Reform Act of 1995 (S.291) to the Senate Governmental Affairs Committee, 104th Congress, Feb. 15, 1995, 1995 W.L. 60882 (F.D.C.H.)

<sup>37</sup> Richard Paton of Canada's Treasury Board is quoted in *Regulatory Efficiency and the Role of Risk Assessment*, at 11.

<sup>38</sup> New Directions Group, *Reducing and Eliminating Toxic Substances Emissions: an Action Plan for Canada* (1991).

with compiling a list (known as List A1) of target substances based on the criteria of toxicity, bioaccumulation and persistence recommended that emissions of polychlorinated biphenyls, polycyclic aromatic hydrocarbons, metal compounds including methyl mercury and chlorinated organics be reduced by 90% by the year 2000.<sup>39</sup> Other substances not meeting all these criteria, or where consensus could not be reached, were placed on lower priority lists with less demanding reduction expectations. By 1995, participating industries managed to reduce emissions of A1 priority substances by 10,300 tons.<sup>40</sup> It should be noted that this is from a pool of potentially allowable industry emissions, and illustrates how a voluntary initiative can reduce pollution without recourse to regulation. A study concludes:<sup>41</sup>

Despite the mistrust among stakeholders, the ARET process has been a qualified success. The drafting of lists of toxic substances was "good science," achieved by political consensus reached through the stakeholder consultation process.... At the present time, we feel that energies should be focused on establishing a more credible verification mechanism for ARET.

If voluntary initiatives can indeed work, then reduced emissions of pollutants like those identified in ARET's A1 priority list will result in corresponding reductions in risk to human health. Further, such measures will reduce the incremental accumulation of toxic substances, allowing sustainable patterns of development to emerge. By themselves, voluntary initiatives will not achieve this convergence. The value of linking risk assessment to sustainable development is that environmental policy can use cost-benefit analysis, economic incentives and voluntary programs like ARET to promote better, safer and more cost effective regulations. In the end, a multimodal approach based on convergence should lead to better environmental policy. Better environmental policy incorporates risk assessment and cost-benefit analysis within a framework of sustainable development. It should lead to better outcomes, i.e., new regulations, new corporate behavior, a truly sustainable economy and better human health.

<sup>39</sup> ARET, *Environmental Leaders* 1, 3 (1995).

<sup>40</sup> *Id.*

<sup>41</sup> Éric Darier & Debora Vannijnatten, *Lessons Learned from ARET: a Qualitative Survey of Perceptions of Stakeholders* (1996).

### Sustainable Risk: Everything in Moderation

From this admittedly incomplete discussion, it appears that risk assessment lacks several necessary conditions for sustainable development, while sustainable development poorly addresses human health. A union of these concepts requires time frame, issues of equity and fairness, the nature of cumulative risk and an appreciation for the value of regulatory reform to be incorporated into environmental policy. Further, market mechanisms including incentives, cost-benefit analysis and voluntary initiatives should make stewardship of the environment a necessary part of promoting economic development while protecting human health. As mentioned, a good name for this new union is "sustainable risk." This concept respects the value of each approach and recognizes that risk is an inevitable part of existence. In essence, the kind, magnitude and distribution of risks borne by industrial societies are determined by regulations and the effectiveness of their implementation and enforcement.<sup>42</sup> Regulations must reflect economic realities. Otherwise, sustainable patterns of development will have a low priority, while risks to human health from a degraded natural environment continue to mount.




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<sup>42</sup> Michael D. Mehta, *Environmental Risk: A Macrosociological Perspective*, in *Environmental Sociology: Theory and Practice* (Michael D. Mehta & Eric Ouellet, eds. 1995).